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Effects of Magnesium Sulphate on Hemodynamic Response to Carbondioxide Pneumoperitoneum in Patients undergoing Laparoscopic Appendicectomy

G Karthikeyan[1], M Dhakshinamoorthy[2]

Author's Affiliation: [1]Post Graduate, [2]Professor, Department of Anaesthesiology, Rajah Muthiah Medical College, Annamalai nagar, Tamil Nadu 608002, India.

Corresponding Author: M Dhakshinamoorthy, Professor, Department of Anaesthesiology, Rajah Muthiah Medical College, Annamalai nagar, Tamil Nadu 608002, India.

E-mail: karthikeyangopalakrishnan83@gmail.com

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Abstract

Carbondioxide pneumoperitoneum in laparoscopic appendicectomy is associated with adverse hemodynamic effects like increases in blood pressure, heart rate and systemic vascular resistance. These adverse effects are due to release of catecholamine and vasopressin. We conducted this randomized double blinded study to assess the effect of magnesium sulphate on attenuating these adverse hemodynamic responses.

Materials and Methods: Sixty ASA I and II patients of either sex aged 20–60 years posted for elective laparoscopic appendicectomy were randomized into two groups of thirty patients each. Group M received magnesium sulphate 20 mg / kg intravenously before creating pneumoperitoneum. Group C received same volume of 0.9 % saline.

Results: Systolic blood pressure, diastolic blood pressure and heart rate were significantly less in patients of Group M when compared to the placebo group.

Conclusion: Magnesium sulphate given at a dose of 20 mg / kg before pneumoperitoneum attenuates adverse hemodynamic responses and ensures better hemodynamic stability during pneumoperitoneum created for laparoscopic surgery.

Keywords: Hemodynamic; Laparoscopic surgery; Magnesium sulphate; Pneumoperitoeum.

Introduction

Laparoscopic surgery is well known as minimally invasive surgery or key hole surgery. In 1983, Kurt semm performed the first laparoscopic appendicectomy. Laparoscopic surgery is the latest surgical technique for operating in abdomen. The abdomen is insufflated with an exogenous gas usually carbondioxide during laparoscopic appendicectomy to create pneumoperitoneum.[1,2] Carbondioxide pneumoperitoneum have adverse hemodynamic effects like rise in blood pressure, rise in systemic vascular resistance and decrease in cardiac output.[3] In response to carbondioxide pneumoperitoneum there is release of catecholamines and vasopressin.[4,5] which causes these adverse hemodynamic responses.The rise in blood pressure and heart rate occurring during carbondioxide pneumoperitoneum will have serious consequences in patients especially those with compromised cardiac function.[6]

In our study, we used magnesium sulphate to attenuate these adverse hemodynamic effects of carbondioxide pneumoperitoneum. Magnesium blocks the release of catecholamines from the adrenal gland and the sympathetic nerve terminals.[7] Magnesium acts on blood vessels to cause vasodilation.[8] Magnesium also attenuates vasopressin induced vasoconstriction.[8]

James et al studied the efficacy of magnesium sulphate administered intravenously in attenuating catecholamine release associated with tracheal intubation. We intend to study the effects of magnesium sulphate in attenuating the adverse hemodynamic responses associated with carbondioxide pneumoperitoneum in patients undergoing laparoscopic appendicectomy.

Materials and Methods

Our study was conducted as a randomized experimental double blinded study in patients undergoing laparoscopic appendicectomy at the department of anaesthesiology, Rajah Muthiah Medical College, Annamalai university, Chidambaram, Tamilnadu.

The study protocol was approved by the ethics committee for human experiments and informed consent was taken from each of the patients. Sixty ASA I and II patients aged 20–60 years undergoing laparoscopic appendicectomy under General Anaesthesia were assigned to one of the two groups each containing thirty patients.

Group M (Magnesiumsulphate group): patients receive magnesium sulphate 20mg/kg diluted in 10ml normal saline intravenously.

Group C (Control group): patients receive 10ml normal saline intravenously.

Patients with hypermagnesemia, known allergy to magnesium sulphate, patients with heart block, hypertension, diabetes mellitus, other systemic disease like cardiovascular disease, kidney disease, endocrine disease, metabolic disease were excluded from the study. All the patients were given T. diazepam 5mg, T. ranitidine 150 mg orally on the night before surgery. Glycopyrolate 0.2 mg was given intramuscularly 45min before surgery. On the arrival to operation theatre, monitors like pulse oximeter, NIBP, ECG were attached. Baseline parameters namely BP, heart rate, SPO_2 were recorded. An intravenous line was secured. A ryle's tube was inserted nasogastrically.

All patients were preoxygenated with 100 % oxygen for three minutes and were administered 1mcg / kg of fentanyl intravenously. Thiopentone sodium 5mg/kg was used for induction and endotracheal intubation was facilitated with succinylcholine 1–2 mg/kg intravenously. The test drug and the placebo drug were given 10 mins before creating pneumoperitoneum. Intraoperative monitoring of heart rate,systolic BP, diastolic BP were done when the test drug given and at 5, 10, 20, 30, 45, 60 mins after pneumoperitoneum. Pneumoperitoneum inflation pressure were maintained between 13 and 15 mmHg. Duringsurgery, anaesthesia is maintained with nitrous oxide 66 % and oxygen 33 % and atracurium 0.5 mg / kg loading dose and 0.1 mg/ kg as maintainence dose. Fentanyl 0.5 mcg / kg was given every 30 mins during surgery. End-tidal carbondioxide was maintained at 35–40 mmHg. At the end of the surgery, ondansetron 4 mg was given for prophylaxis against post operative nausea and vomiting. Residual neuromuscular blockade was reversed with neostigmine 0.05 mg / kg and glycopyrolate 0.01mg/kg, Extubation was done under thorough suction. Patients were observed in the postoperative period for sedation using Ramsay's sedation score. Patients were also monitored for signs of hypermagnesemia in the postoperative period.

The results obtained from the study were presented in the following section. The data was entered into Microsoft excei 2013. The data was then imported into SPSS (Statistical package for social sciences) version 23 by IBM corporation for analysis. Descriptive stastistics and inferential statistics included mean, proportion and percentages. Inferential statistics included unpaired 't' test, chi square test and repeated measures ANOVA.

Results

Both the groups were comparable with respect to demographic profile (age, sex) and did not vary significantly between the two groups (Tables 1, 2).

There was a significantly greater decrease in heart rate in the group M as compared to the group P (Fig. 1) ($p < 0.05$). There was a significantly greater decrease in the systolic BP in the group M as compared to the group P (Fig. 2) ($p < 0.05$). There was a clinically significant greater decrease in diastolic BP in group M as compared to group P (Fig. 3). Postoperative sedation is evaluated with Ramsay sedation score and it is comparable in both the groups.

Table 1: Age Distribution.

Group	N	Age		T value	dof	P value
		Mean	SD			
Magnesium group	30	32.37	11.02	0.012	58	0.991
Control group	30	32.33	11.01	0.012	58	0.991

Table 1 shows no significant difference in age distribution between 2 groups.

Table 2: Sex Distribution.

Sex	Magnesium group		Control group		Total	
	n	%	n	%	n	%
Male	14	46.7	17	56.7	31	51.7
Female	16	53.3	13	43.3	29	48.3
Total	30	100	30	100	60	100

X^2 : 0.601; p value : 0.438 (> 0.05)

Table 2 shows there is no significant difference in the sex distribution between both groups.

Table 3: Sedation Score Table.

Sedation score	Magnesium group		Control group		Total	
	n	%	n	%	n	%
Score 1	13	43.3	13	43.3	26	43.3
Score 2	17	56.7	17	56.7	34	56.7
Total	30	100	30	100	60	100

X^2 : .000 df : 1 p value : 1.000 (> 0.05).

Table 3 shows there is no significant difference in the sedation score between both groups.

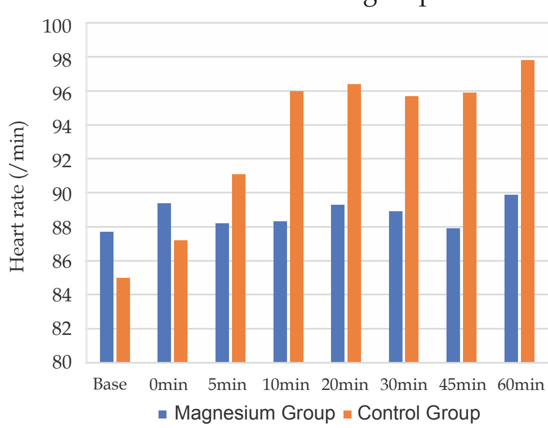

Fig 1: Changes In Heart Rate.

Fig 1 shows heart rate is significantly lower in the magnesium group when compared to the control group.

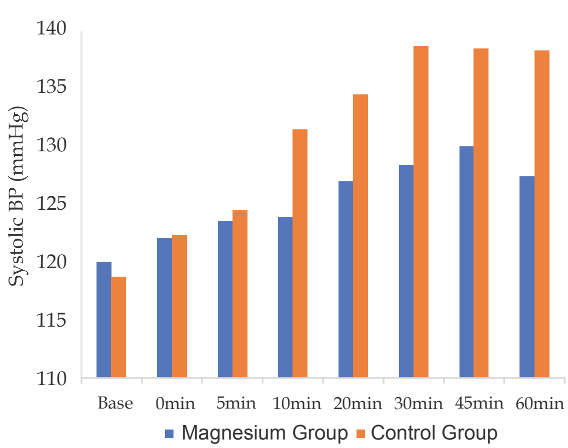

Fig. 2: Mean Systolic BP.

Fig 2 shows systolic BP is significantly lower in the magnesium group when compared to the control group.

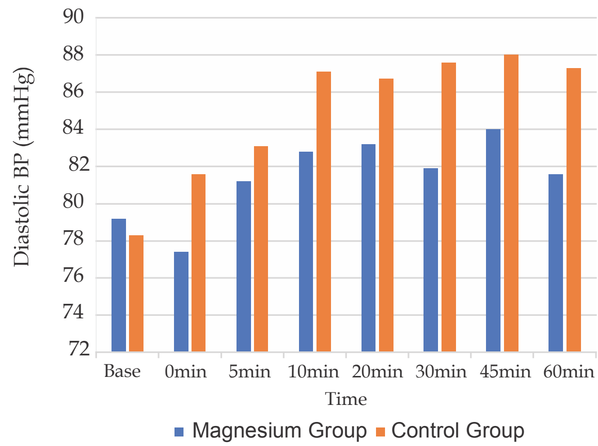

Fig. 3: Changes In Diastolic BP.

Fig 3 shows diastolic BP is significantly lower in the magnesium group when compared to the control group.

Discussion

In our study, we investigated the effects of magnesium sulphate on hemodynamic response to pneumoperitoneum during laparoscopic appendicectomy. In laparoscopic procedures, pneumoperitoneum is usually created with carbondioxide.[10,11] Magnesium sulphate is one of the therapeutic regimens used to optimize adverse hemodynamic responses to pneumoperitoneum. Magnesium sulphate has direct vasodilator action[12] and also attenuates the release of catecholamines.[13] Raised IAP associated with pneumoperitoneum and carbondioxide absorbed systemically cause adverse hemodynamic responses.[14] With the creation of pneumoperitoneum, there is immediate increase in catecholamine and vasopressin levels in the blood. This sympathetic stimulation activates the renin-angiotensin aldosterone system (RAAS), which induces hemodynamic changes[14,15] like reduced cardiac output, raised arterial pressure, elevated systemic and pulmonary vascular resistance.[16] Various drugs have been studied and utilized to blunt these adverse hemodynamic alterations associated with pneumoperitoneum. As mentioned earlier, magnesium sulphate is effective in attenuating the release of catecholamines from the adrenergic nerve terminals and the adrenal gland.[17] In addition, magnesium sulphate acts directly on the blood vessels[18] to cause vasodilation. Vasopressin also contributes to the hemodynamic changes associated with pneumoperitoneum. Magnesium suiphate modulates the vasoconstriction caused by vasopressin.[19] The study conducted by James et al[20] revealed that magnesium sulphate can optimize the adverse hemodynamic effects associated with endotracheal intubation. We also studied the effect of magnesium sulphate administered intravenously at a dose of 20 mg/kg to attenuate the hemodynamic response to pneumoperitoneum. Telci et al[21] studied the efficacy of magnesium sulphate to reduce anaesthetic requirements. They gave magnesium sulphate 30 mg/kg as bolus before induction then 10 mg/kg/hr as continuous infusion. In our study, we do not intend to study the efficiency of magnesium sulphateto decrease the anaesthetic requirements. So we did not give any magnesium sulphate infusion intra operatively. Still it is observed in our study that magnesium sulphate 20 mg/kg diluted in 10 ml normal saline administered 10 min before pneumoperitoneum was able to attenuate the hemodynamic alterations. Diament et al[22] observed in their study conducted in dog that 35% decrease in cardiac output with an IAP of 40 mmHg. Ishizaki et al[23] observed in their study, a significant fall in cardiac output at 16 mmHg. They also observed that hemodynamic alteration were not that much with IAP of 12 mmHg. We also tried to keep IAP of 12–13 mm Hg in our study. Inspite of maintaining 12–13 mmHg and normocapnia, there was significant rise in arterial pressure and heart rate in the control group. However in the magnesium sulphate group hemodynamic changes to pneumoperitoneum were effectively attenuated and both arterial pressure and heart rate remained at significantly lower level compared to control group. We observed in our study that magnesium sulphate administered intravenously before creating pneumoperitoneum at a dose of 20 mg/ kg effectively attenuated the adverse hemodynamic responses. In our study, no patient of either group suffer from tachycardia or hypotension. Hypertension occurred in few patients in the control group which was managed with inj. Nitroglycerine.

Conclusion

We conclude that, magnesium sulphate used in our study provided better hemodynamic stability in patients undergoing laparoscopic appendicectomy. Hence magnesium sulphate is effective in attenuating adverse hemodynamic responses during laparoscopic appendicectomy.

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